Solar Water Heating

Using the Sun to Heat Domestic Water Makes Sense in Almost Any Climate

More than 1 million homeowners and 200,000 businesses in the United States are using the sun to heat domestic water efficiently in almost any climate. In summer, a solar system properly sized for a residential building can meet 100% of the building's water-heating needs in most parts of the country. In winter, the system might meet only half of this need, so another source of heat is used to back up the solar system. In either case, solar water heating helps to save energy, reduce utility costs, and preserve the environment.

A solar water-heating system's performance depends primarily on the outdoor temperature, the temperature to which the water is heated, and the amount of sunlight striking the collector—the device that actually captures the sun's energy. "Active" solar water heaters use pumps to circulate water or some other fluid from the collectors, where the water is heated by the sun, to the storage tank, where it remains until needed. Active systems fall into two general groups: indirect systems, which use a fluid with a low freezing point (such as propylene glycol) in the collector loop, and direct systems, which use water in the loop. The water drains automatically when the sun isn't shining.

"Passive" solar water heaters, which rely on gravity to work, are typically either integral collector/storage (ICS) systems or thermosyphon systems (see box on reverse). The chief advantage of these systems is that they don't need controls, pumps, sensors, or other mechanical parts, so maintenance requirements are minimal. They are less expensive than active solar systems and should be used only in warm, sun-belt climates. Roof-mounted systems require a structure that is able to support the storage tanks.

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An active solar heating system supplies hot water to the visitors center at Mt. Rushmore.

There are four basic types of solar collectors: unglazed swimming pool heaters, and flat-plate, evacuated-tube, and parabolic-trough collectors. An unglazed swimming pool heater is a plastic absorber with extruded flow passages. It is useful for low-temperature applications in which heat losses to the ambient air are negligible.

A flat-plate collector is a panel-shaped box containing fluid-filled tubes mounted on a dark-colored absorber. It is suitable for residential and nonresidential uses, and it operates well in humid climates where the sunlight is more hazy and diffuse rather than direct.

In an evacuated-tube collector, the absorber plate is surrounded by a glass tube, and a vacuum between the plate and tube provides enough insulation to reduce heat losses. The collector operates at high temperatures with high efficiency when using both direct and diffuse light.

A parabolic-trough collector consists of a long, U-shaped mirror (trough) that focuses the sun onto a fluid-filled tube along the center of the trough. This highly efficient system typically tracks the sun and requires direct, not diffuse, sunlight. It is used chiefly in nonresidential and institutional applications, such as prisons and hospitals.

What are the opportunities for solar water heating in the Federal government?

Solar water heating is appropriate for all types of buildings:

- *Residential*—for showers, kitchens, and laundry areas in housing units, dorms, and barracks, for example.
- *Commercial*—such as recreational facilities with showers and large facilities with cafeterias, day care centers, or laundry rooms.
- *Institutional*—such as libraries, schools, hospitals, clinics, and prisons.

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What are the important terms?

Drainback system—A system in which water in the collector loop drains into a reservoir tank when the pump stops.

Draindown system—A system in which water flows from the collector loop and piping into a drain in freezing weather conditions. Historically, this is less reliable than a drainback system.

Integral collector/storage (ICS) system—Also called a "batch" or "breadbox" water heater, this system is appropriate for mild climates; it combines a collector and storage tank into one unit. Sun shining on the collector strikes the storage tank directly, heating the water. The water's large thermal mass, along with the insulation that reduces heat loss through the tank, prevents the stored water from freezing.

Recirculation system—Whenever freezing weather conditions occur, warm water from storage is circulated through the collectors and exposed piping; the system is best for mild climates.

Thermosyphon system—Has a separate storage tank above the collector. Warm, less-dense liquid in the collector rises naturally above it and remains there until needed. As water cools in the tank, becoming more dense, it naturally sinks back down to the collector.

Solar water heating works in all climates, although ICS and thermosyphon systems work best in warm regions. Some utilities are encouraging solar water heating as a demand-side management strategy; some offer rebates and other incentives in the areas they serve.

What is required?

Stable heating load—The water heating load should be relatively constant throughout the week and the year; systems in buildings that are closed down for several days at a time or for an entire season (such as schools) have longer payback periods because the solar system is not being used at those times.

Cost-effectiveness—A solar system is usually more cost effective if it displaces a high-cost energy system, such as an electric or propane water heater.

Installation area—There must be enough room on the roof or the ground for a properly sized collector; the roof should be unshaded and either flat or tilted south. The required collector area is about 1 to 1.5 square feet for each gallon of water used per day on average.

Training—Facility managers and other appropriate personnel should know how the system works and receive training in how to maintain it.

What does it cost?

Solar water heaters typically provide 40%–80% of a building's annual water-heating needs. Costs range from $27.50 to $115 per square foot, depending on the size and type of system selected. The economics are most favorable when solar heating is compared with electric water heating. However, this varies according to the specific location, amount of water use, and utility rate. The economics are often better for new-construction systems than for retrofits because the cost of installing new systems is usually lower.

The Solar Rating and Certification Corporation (SRCC) tests performance and certifies almost every solar water heater on the market today. The SRCC—an independent, nonprofit organization directed by state government personnel, solar industry representatives, and consumer groups—determines system performance in accordance with national ratings standards. SRCC certification allows consumers and Federal agencies to choose wisely among various systems and to be confident that the system will perform as promised.

For More Information

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